VOLUME XXV NUMBER 3 WHOLE NUMBER 202

THE JOURNAL

OF

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

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THE JOURNAL

OF

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

VOL. XXV, No. 3 MARCH, 1931 WHOLE No. 202

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THE JOURNAL
OF
THE ROYAL ASTRONOMICAL SOCIETY
OF CANADA

VOL. XXV, No. 3 MARCH, 1931 Whole No. 202

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA "AT HOME"

THE annual "at home" of the Royal Astronomical Society of Canada was held on Tuesday evening, January 20, 1931. A large number of invitations had been sent out, and a representative gathering assembled in the large lecture hall of the Physics Building of the University at 8 p.m.

The First Vice-President, Professor R. K. Young, as Chairman, welcomed the assembled members and friends.

Dr. H. R. Kingston, president of the Society, gave a popular address on "Other Worlds in our Solar System."

Just as there are striking similarities and striking contrasts between members of an ordinary family, so in the sun's family of children we find many points in which they resemble one another, and, again, many characteristics in which they differ sharply.

In the case of the solar family, the parent, the sun, is quite unlike any of his children in size, in mass, in temperature, and in many other ways. The sun has a surface temperature of about 11,000° Fah.

As we leave the earth and journey out into space, the first large body we meet is the moon. What a contrast there is between the moon and the earth! The earth has a great atmosphere around it while the moon has none. On the earth there is a more or less equable temperature at one place, while on the moon the temper-

ature changes from the boiling point of water at noon to about 340° below zero at night. The moon, having no atmosphere, is also devoid of sound. It is a world where the silence of death reigns.

In late years actual temperatures of most of the planets have been determined by delicate instruments.

The planet Mercury also has no atmosphere, but being closer to the sun than the earth it has a much higher temperature. At mid-day, at a point where the sun is directly overhead, its temperature is about 660° Fah. (that is, the melting point of lead), while on the other side the cold is so intense that we cannot measure it exactly. It is probably about absolute zero.

Venus presents a sharp contrast to Mercury, having around it a vast atmosphere which precludes any view of solid surface of the planet. Its temperature is, on the average, a little below zero.

Passing out beyond to the planet Mars, we find a world with some atmosphere but much less than that possessed by the earth. The temperature at a point on this planet at noon is sometimes about the same as that of a cool summer day, and then again it may be absolute zero because of the varying distance of Mars from the sun.

The planets Jupiter, Saturn and Uranus are so far away that their temperatures are around 200, 240, and 280 degrees Fah. below zero, respectively. They have tremendous atmospheres surrounding them and consequently we never see their surfaces.

The lecturer referred to the coming approach of the little planetoid Eros, which comes within 16,000,000 miles of the earth on the last day of January. Astronomers are making great use of this fact to find, if possible, a more accurate scale for the size of our solar system.

The new planet Pluto came in for a brief discussion. It is now firmly established that it is a planet and not a comet. It is about 4,000,000,000 miles from the sun and requires 249 years to make one revolution around the sun. It is so far away that its temperature must be that of liquid air, or, possibly, closer to absolute zero.

The lecture closed with a brief discussion of meteors and meteorites, with special reference to the great fire ball which fell in Siberia on the 30th of June, 1908. This meteor was on a huge scale and blotted out all life within a radius of 20 or 25 miles. The blast

of hot air sent out when it struck the earth also flattened the forests in every direction for many miles, searing the trees and tearing off their bark. If such a catastrophe occurred in a modern city the entire city would be blotted out instantaneously. Fortunate it is that such occurrences are rare.

The lecture was illustrated with a number of lantern slides.

At the close of the lecture the Chairman referred to the long continued and many services rendered the Society by Dr. C. A. Chant, the Editor of the JOURNAL and Librarian of the Society, and on behalf of the Council of 1930 presented him with a desk set carrying a replica of the crest of the Society mounted as a medallion, a token of the Council's appreciation of his services on his retiring as Librarian. In accepting the gift and thanking the Council, Dr. Chant described the early days of the Society and expressed the hope that he would be able to continue his services as Editor of the JOURNAL with the aid of the handsome pens which he had received.

The audience expressed their pleasure with the incident, and proceeded to enjoy the refreshments, and the opportunity for a social time.

E. J. A. KENNEDY,
Recorder.

ANNUAL GENERAL MEETING OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

THE meeting was held in the Physics Building of the University of Toronto on January 13, 1931, at 8 p.m. Professor R. K. Young, first vice-president, presided.

The Minutes of the Annual Meeting of 1930 as printed in the JOURNAL for March, 1930, were confirmed.

In the absence of the General Secretary, who was unavoidably detained, the Chairman presented the Reports of the following centres—Montreal, Ottawa, Winnipeg, London and Toronto; these were received and adopted.

The Report of the General Treasurer was read by Dr. R. K. Young, and approved.

The Librarian and the Curator were present and read their reports; these were received and adopted.

The General Secretary's Report on Membership was received and approved. A letter from Mr. R. G. Madill of Ottawa Centre was read, in connection with the disposal of the revenue from newspaper articles written by a number of the Society's members. This letter was referred to the General Council for action.

A letter from Mr. H. W. Barker was received in which he stated his wish to be relieved of the office of General Treasurer; this letter was referred to the General Council.

There was some discussion in regard to the Building Fund, arising out of the General Treasurer's report. A special committee was already in existence to deal with the investment of funds in the Society's name, and the meeting wished the committee to bring in a final report to Council as soon as possible.

Reference was made to the addition to the By-Laws, which, after being approved by Council and by vote of the members, was adopted by Council, December 2nd, 1930.

The scrutineers announced that 130 ballots had been returned and the results were almost unanimously in favour of those named on the ballot. The Chairman therefore declared the following duly elected as officers of the Society for 1931:—

Honorary President—R. M. Stewart, M.A., F.R.S.C., Ottawa.
President—H. R. Kingston, M.A., Ph.D., London, Ont.
First Vice-President—R. K. Young, Ph.D., Toronto.
Second Vice-President—Mgr. C. P. Choquette, M.A., Lic. Scs., Montreal.
General Secretary—L. Gilchrist, M.A., Ph.D., Toronto.
General Treasurer—H. W. Barker, Toronto.
Recorder—E. J. A. Kennedy, Toronto.
Librarian—R. A. Gray, B.A., Toronto.
Curator—Robert S. Duncan, Toronto.
Council—D. S. Ainslie, Toronto; F. Napier Denison, Victoria; Miss A. Vibert Douglas, Ph.D., Montreal; J. H. Horning, M.A., Toronto; Ernest A. Hodgson, M.A., Ottawa; Ralph E. DeLury, M.A., Ph.D., Ottawa; John Patterson, M.A., Toronto; J. A. Pearce; M.A., Ph.D., Victoria; John Satterly, M.A., D.Sc., Toronto, L. A. H. Warren, M.A., Ph.D., Winnipeg.

A vote of thanks to the auditors, Mr. A. R. Hassard and Dr. J. B. Fraser was adopted, and they were requested to act for the coming year.

E. J. A. KENNEDY,
Recorder.

MEMBERSHIP OF THE SOCIETY

The membership of the Society on December 31, 1930, as shown by the reports of the different centres, was as follows:—

	1930	1929
Toronto	164	269
Ottawa	67	61
Victoria	117	113
Montreal	114	112
Winnipeg	46	54
London, Ont	52	39
Hamilton	82	..
Members at large	96	..
	738	648

	1930	1929
Honorary Fellows	10	11
Life Members	15	13
Subscribers to *Journal*	64	59
	89	83

E. M. BUDD,
Assistant Secretary.

LIBRARIAN'S REPORT

During 1930 the Library was continued as in previous years, nothing occurring to alter the even tenor of its way.

The Assistant Librarian has prepared the following statistics:—

Number of periodicals received during 1930:

From Canada and the Empire	153
From the United States	211
From other countries	191
	555

The *Journal* was sent in exchange to addresses in:

Canada and the Empire	45
The United States	53
Other countries	45
	143

Most of the new books on astronomy published in 1930 have been added to the Library. A list of some of these was given in a recent number of the JOURNAL.

Upon retiring from the office of Librarian, I regret that I cannot report that more spacious and convenient quarters for the library have been secured. The need is great but the manner in which the required accommodation will be obtained is not evident at present.

C. A. CHANT,
Librarian.

CURATOR'S REPORT

The Larratt Smith telescope was in use at Grimsby during the summer. The large Cooke telescope has been in the possession of Mr. Fred L. Troyer since midsummer, and interest in the use of telescopes is increasing generally. The demand for slides has been light. Some time ago the assistant curator and myself went over the Society's collection of slides, and came to the conclusion that, if possible, the collection should be renovated and brought up to date, and a lot of damaged ones, and reproductions from crude illustrations might be discarded as being hardly in keeping with the Royal Astronomical Society of Canada.

ROBERT S. DUNCAN,
Curator.

REPORTS OF THE SECRETARIES OF CENTRES

TORONTO

We have to report a greatly reduced membership due to the transfer of no less than 96 members who are now included in a group designated "Members at Large". This procedure is in accordance with an amendment to the By-Laws of the Society during the past year; the members transferred are all residents of other countries or distant parts of Canada. We have also lost 7 members to the new and vigorous Hamilton Centre which came into being during 1930.

It is with great regret we list the names of members who have passed on during the year:—Major A. D. Armour, D. E. Eason, B.Sc., J. A. Paterson, K.C., J. H. Knowles, T. Waddell. In the passing of these members the Society generally, as well as the Centre, has sustained a severe loss. Mr. Paterson was one of the Charter Members, and also a Past President. Separate reference has been made in the JOURNAL to the life and activities of Mr. Paterson and others.

The Toronto membership now stands at 164. We started with 269; transferred 104, deaths 5, temporarily removed from mailing list 9, leaving a balance of 151; and 13 elected during the year gives a present membership of 164.

Our Annual business meeting was held on December 16, at which the following officers were elected for the year 1931:—

Honorary President—Sir Frederic Stupart.
Chairman—R. A. Gray, B.A.
Vice-Chairman—A. R. Hassard, B.C.L.
Secretary—E. J. A. Kennedy.
Treasurer—H. L. Rogers.
Curator—R. S. Duncan.
Assistant Curator—F. L. Troyer.

There have been 14 meetings held during the year—8 during the winter and spring and 6 during the autumn.

It is safe to say that all the papers presented have been interesting and have been appreciated by the members. The meetings have been generally well attended.

The Observational Section established recently is getting under way and promises to add additional interest to our work.

We have made considerable progress during the past year, 1930, and expect to make still further progress during 1931.

J. R. COLLINS,
Chairman.

E. J. A. KENNEDY,
Secretary.

OTTAWA

During the year 1930, five public lectures were given by the Ottawa Centre in the lecture hall of the Victoria Memorial Museum, as follows:—

Jan. 24—Meteorology of Northern Canada, by John Patterson, M.A.
Feb. 28—Interesting Objects in the Sky, by Dr. R. K. Young.
Mar. 28—Solar Eclipses, by Dr. R. E. DeLury.
Oct. 31—Arctic Explorations, by Major L. T. Burwash, F.G.S.C.
Nov. 28—Jeans and Eddington, by Dr. A. Vibert Douglas.

In addition to these open meetings, three regular council meetings and five emergency meetings were held during the year.

Through the kindness of the director of the Dominion Observatory, Mr. R. Meldrum Stewart, members and their friends were again invited to the observatory for a soirée. This event took place on May 2, and was very much enjoyed.

The membership now stands at 67, showing an increase of four over that of last year. Two of our members have passed on since the last annual meeting—H. S. Winchester and Senator Turriff. Six new members have been added to the society, and one transferred here from the Toronto Centre. Only one resignation has been reported.

This year a number of requests for the *Observers' Handbook* have been received, and it is encouraging to see this increased interest in the subject.

The custom was continued of sending the various issues of Saturday evening programs published by the Dominion Observatory to the members.

MIRIAM S. BURLAND,
Secretary.

VICTORIA, B.C.

Membership.—Number of members, Jan. 1, 1930 111
Elected during the year—B. Huffman, J. H. Murray, Dr. A. E. Clendenan, J. W. Winson, Dr. L. I. Bull, Frank S. Stevens, Oscar Whittaker, W. W. Blatchford, Mrs. L. K. Potts, Mrs. V. K. Clarke, Rev. J. W. House, Dr. H. W. Hill, J. Teasdale, George Walsh, F. R. Williams 15

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Resignations	4	
Deaths	2	
Transferred to Toronto Centre	1	
Membership lapsed	2	
	—	9
Present membership		117

Attendance.—Sixty members live in or near to Victoria. Of these, it is estimated that between one-fourth and one-half attend the meetings. The Council will probably welcome suggestions for making the meetings attractive to a larger proportion. One suggestion is that there be a period for questions half-way through a lecture. This may be welcomed both by lecturer and audience.

Meetings.—In addition to three Council meetings during the year and observational meetings during the summer months, there have been the following eight regular meetings of this centre:

Jan. 28—The Rotation of the Galaxy, J. S. Plaskett, F.R.S.

Feb. 25—Progress in Astronomy during 1929, W. E. Harper, M.A.

Mar. 25—Surveying from the Air, N. C. Stewart, Esq.

Apr. 29—Symposium: The Origin of the Solar System
(*a*) The Nebular Hypothesis, R. W. Hunter, Esq.
(*b*) The Planetesimal Hypothesis, P. H. Hughes, Mus. Bac.
(*c*) The Collision Theory, R. O. Redman, B.A.
(*d*) The Satellites of the Planets, James Duff, M.A.

Sept. 2—The Sun, H. H. Plaskett, B.A.

Sept. 23—The Globular Star Clusters, P. ten Bruggencate, Ph.D.

Oct. 28—The Atmosphere of the Earth, H. G. Smith, Ph.D.

Nov. 25—The Value of Scientific Research, C. S. Beals, Ph.D.

PHILIP H. HUGHES,
Secretary.

Montreal

During the past year there were three regular meetings of the Society and two special lectures under the auspices of the McGill University Extension and Extra-Mural departments to which members were invited. The subjects and speakers were as follows:

Oct. 31, 1929—The Earth Beneath, in the Light of Modern Seismology, E. A. Hodgson, M.A., Ottawa.

Nov. 21, 1929—Telescopes and the Universe they Reveal, the Secretary.

Feb. 5, 1930—Variable Stars, Dr. S. Rosseland, Director, Oslo Observatory.

Feb. 27, 1930—Relativity, Prof. A. H. S. Gillson, McGill University.

Mar. 25, 1930—Jeans and Eddington, the Secretary.

With deep regret we record the death of our 1st vice-president, Dr. J. B. McConnell, also of Mr. J. T. Armand, a valued member of the Council since 1927, and of Dr. J. N. P. Fournier, a member of the Society for many years.

Nine new members were elected during the year. The membership now stands at 114, of whom 27 have not paid their 1930 membership fee which was due last January. Delays and omissions in this matter of fees very greatly increase the work of the secretary and handicap the entire Society, as it diminishes the grant that we receive from the General Treasurer.

A. Vibert Douglas,
Secretary.

Winnipeg

During the year 1930, nine meetings were held in Theatre "A," University of Manitoba. These meetings were open to the public and were well attended.

On July 17, the Winnipeg Centre united with the Scientific Club in arranging a luncheon at the Fort Garry Hotel in honour of Dr. and Mrs. J. S. Plaskett, who were returning from a visit to England. On this occasion those present had the pleasure of hearing Dr. Plaskett give an address on the history of astronomy in Canada. The following papers were given at the meetings held during the year:

Jan. 8—The Ancient Measurement of Time, Mrs. J. C. Howey.

Jan. 22—Special meeting in charge of Mr. D. R. P. Coats.
Astronomical phonograph records:
"Spring Stars"; "Summer Stars"; "Autumn Stars"; "Winter Stars," Professor Hall Turner of Oxford.
"Time and Space," Sir Oliver Lodge.

Feb. 12—Astronomy through the eyes of the Ancients, Mrs. E. L. Taylor.
Sun Spots, Rev. F. X. MacAulay.

Mar. 12—Colour in Astronomy, Right Rev. T. W. Morton.

April 5—Members' Night—Ten-minute talks:
April Stars, Mr. A. W. Megget.
A Note on Comets, Mr. C. E. Bastin.
Mount Wilson Observatory, Dr. N. J. MacLean.
The Universe Around Us, Mr. Cecil Roy.
The Origin of the Moon, Mr. R. McCalman.
Algol, Mr. J. H. Kolb.
Recitation entitled "Voices of the Suns," Mr. D. R. P. Coats.

April 23—Eclipses, Dr. L. A. H. Warren.

Oct. 7—How to Determine the Position of the Stars, Dr. L. A. H. Warren.

Nov. 12—A Visit to the Adler Planetarium, Mrs. H. M. Sweet.
The Immensity of the Universe, Mrs. E. L. Taylor.

Dec. 10—Refraction of Light, Dr. L. A. H. Warren.

Observation meetings were held on several occasions under the leadership of Mr. A. W. Megget.

At the annual meeting, which was held on December 10, the following officers were elected for 1931:

President—Neil John MacLean, M.D., F.A.C.S.

Vice-President—Mr. A. W. Megget.

Treasurer—Mr. J. H. Kolb.

Secretary—Mrs. J. Norris.

Council—Mr. D. R. P. Coats, Mr. James Houston, Professor V. W. Jackson, Mr. R. McCalman, Right Rev. T. W. Morton, Mrs. E. L. Taylor, Dr. L. A. H. Warren.

Auditors—Mr. James Houston, Mr. R. McCalman.

Programme Committee—Dr. N. J. MacLean, Mr. A. W. Megget, Mrs. E. L. Taylor.

Nominating Committee—Mr. C. E. Bastin, Mrs. J. C. Howey, Mrs. H. M. Sweet.

S. C. NORRIS,
Secretary.

London

During the year 1930, the Society held eight regular meetings, all of which were well attended.

Jan. 10—Evolution of the Solar System, H. R. Kingston, Ph.D.

Feb. 14—The Interior of the Earth and the Cause of Earthquakes, J. W. Russell, M.A.

Mar. 14—The Tidal Theory of the Birth of the Solar System, H. S. Wismer, M.D.

April 11—Eclipses, with Special Reference to Eclipses of the Month, H. R. Kingston, Ph.D.

May 9—Telling Time by the Stars, John Dearness, LL.D.

June 13—Observational meeting and picnic at the summer home of Mr. and Mrs. W. E. Saunders at Pond Mills.

Oct. 10—Finding Your Way by the Stars, H. R. Kingston, Ph.D.

Nov. 14—Meteors and Meteorites, Bolides and Fireballs, Rev. R. J. Bowen, F.R.G.S.

Dec. 12—Annual Meeting—Election of officers and social evening.

Two Council meetings were held—one at Dr. Kingston's residence, Dec. 30, 1929, to draft the 1930 programme, and one at the secretary's office, Sept. 18, 1930, to discuss the possibility of purchasing a telescope. On Friday evening, Jan. 24, 1930, the members of the Society were the guests of Mr. J. C. Middleton at his home. On Friday evening, Sept. 26, the members of the Society at an informal dinner at Wong's café, Richmond street, tendered to Mr. W. E. Harper, M.A., of the Dominion Astrophysical Observatory at Victoria, B.C.

The active membership for the year was 53.

Officers for 1931

Hon. President—Dr. H. R. Kingston.

President—Mr. E. H. McKone, R.R. No. 1, London.

Vice-President—Miss N. Morris.

Secretary-Treasurer—Mr. G. R. Magee, 427 William St., London.

Council—Mr. F. H. Coates, Mr. S. A. Olheiser, Miss Florence Fisher, Mr. Wendell Holmes, Miss A. E. Henderson.

H. S. Wismer,
Secretary.

GENERAL TREASURER'S FINANCIAL STATEMENT

GENERAL ACCOUNT

Receipts, 1930

Cash in Bank, December 31, 1929	$ 722.80
Grant from Dominion Government	2,000.00
" " Provincial Government	600.00
" " City of Toronto	100.00
University of Toronto (75 *Journals*)	150.00
Subscriptions to *Journal* and Reprints	247.00
Southam Press for Astronomical Articles	452.50
Fees of Members	1,044.00
Bank Interest	39.16
	$5,356.26

Disbursements, 1930

Publication *Journal* and *Handbook*		$2,792.36
Library Books and Binding		88.65
Salary, Assistant Librarian		620.00
Stationery and Stamps		212.38
Rent of Library and Office		120.00
Grants—London Centre	$ 50.00	
Montreal "	136.00	
Ottawa "	57.00	
Toronto "	162.00	
Victoria "	73.00	
Winnipeg "	80.50	
Hamilton "	50.00	
		608.50
Expenses "At Home"		67.61
Transfer to Life Membership account		99.44
Fire Insurance (three years)		34.00
Telescope Repairs		43.00
Gold Medal to Mr. P. M. Millman		25 00
Miscellaneous Expenses		52.35
Toronto Meetings—Balance due 1928		70.12
Bank Balance		522.85
		$5,356.26

BUILDING ACCOUNT

Receipts

Balance, December 31, 1929	$ 668.44
Interest on Bonds	168.81
Interest on Bank account	21.10
Balance in Bank, a/c No. 4383	$ 858.35

LIFE MEMBERSHIP ACCOUNT

Receipts

Balance, December 31, 1929	$ 68.00
Membership Fees	50.00
Interest on Bonds	5.00
Interest on Bank a/c 4390	2.56
Transfer from General Funds	99.44
Balance in Bank	$ 225.00

MEMO OF BONDS HELD BY IMPERIAL BANK

Building Account—Canada Permanent Debentures:	
L 13275	$ 500.00
L 15591	500.00
2	500.00
L 3754	500 00
Dominion of Canada T/E 18682 (5½)	1,000 00
Life Membership Account—Canada Permanent Debenture	
L 3892	100.00
	$3,100.00

(Signed) H. W. BARKER,
General Treasurer.

Audited and found correct,
January 9, 1931.

(Signed) A. R. HASSARD,
JNO. B. FRASER, M.D.,
Auditors.

TORONTO FINANCIAL STATEMENT

1930			
	Receipts		
Jan. 7	In Bank of Commerce (Yonge and College Branch)	$ 22.23	
Jan. 10	Deposited from General Treasurer	56.55	
Apr. 4	Deposited from General Treasurer, balance due from last year	70.12	
May 21	Deposited from General Treasurer, one half of membership fees	162.00	
Dec. 3	Deposited cash on hand	5.32	
Dec. 30	Refund from rent of room	8.50	
	Petty cash	.25	
			$324.97
	Disbursements		
	Lecturers		
Mar. 18	Miss A. Vibert Douglas	$ 33.70	
Apr. 4	Dr. H. R. Kingston	12.15	
Nov. 13	R. Meldrum Stewart	16.15	
Dec. 4	Dr. H. R. Kingston	15.00	
Dec. 16	Rev. Dr. D. B. Marsh	6.40	
			$ 83.40
	Printing		
	Programmes	17.43	
	Mimeographing	27.10	
			44.53
	Advertising		
	Evening Telegram	20.35	
	Daily Star	17.17	
	Globe	10.53	
	Mail and Empire	7.58	
			55.63
	Miscellaneous		
	Telegrams from Harvard	$ 16.30	
	Rent of lecture room (University of Toronto)	64.50	
	Refund to General Office	34.43	
	Bank Charges	2.00	
	Petty Cash	10.00	
	Cash in Bank	14.18	
			161.41
			$342.97

Grant of $100 from City of Toronto still to be received from General Treasurer.

Audited and found to be correct.
A. R. HASSARD,
JOHN B. FRASER, *Auditors.*
January 13, 1931.

EVELYN M. WATT,
Treasurer.

OTTAWA FINANCIAL STATEMENT FOR 1930

1930			1930	
Jan. 1	Balance in Bank	$137.84	Postage on bills and notices issued by Treasurer in 1929	$1.24
	Balance on hand	10.00	Postage on notices issued by Secretary during 1930	7.00
	Fees collected and deposited	62.00	Runge Press, cards	3.75
	Fees on hand	18.70	Mutual Press, cards	2.00
	Remittance from Toronto	56.70	R. K. Young, lecture	25.00
	Interest on deposit	4.10	Mrs. L. Sabourin (catering)	48.00
			Miss V. Douglas, lecture	20.00
			Balance in Bank	173.65
			Cash on hand	18.70
		$289.34		$289.34

Examined and found correct.
(Signed) D. B. NUGENT, *Auditor.*
December 19, 1930.

(Signed) A. W. GRANT,
Treasurer.

MONTREAL FINANCIAL STATEMENT
Nov., 1929-Oct., 1930

Receipts

Balance brought forward		$186.39
96½ fees	1929 ..... 10 1930 ..... 84½ 1931 2	193.00
Balance on one Life Membership		17.00
Bank Interest		2.92
Grant from Gen. Treas., 1929		136.00
" " " 1928 (balance)		38.00
Donation to Montreal Centre		23.00
		$596.31

Expenditures

Meetings—Janitor, lantern, etc.	$ 8.50
Lecturer's expenses, accommodation and taxis	87.50
Telegrams	.64
Advertisement in Star	3.99
Stamps, stationery, typing, etc.	12.75
Exchange on cheques	.75
Remitted to General Treasurer, 93 fees and one Life Membership	211.00
	$325.13
Balance in Bank and cash	271.18
	$596.31

Audited and found correct.
(Signed) W. E. LYMAN.
October 30, 1930.

A. VIBERT DOUGLAS,
Treasurer.

WINNIPEG TREASURER'S REPORT

Receipts

Balance statement of 1929		$ 94.29
Bank Interest	$ 3.30	
Grant from General Treasurer	80.50	
Subscriptions, 1930	63.00	
Donation	.50	
		147.30
		$241.59

Disbursements

Advertising	$31.88	
Printing	11.67	
Operation of lantern	12.00	
Honorarium (Mr. Chubb)	5.00	
Fort Garry Hotel (Dr. Plaskett)	7.65	
Bank exchange	.37	
Postage	1.20	
Flowers	4.00	
Remitted to Toronto	63.00	
		$136.77
Balance in Bank, December 10, 1930		104.82
		$241.59

Audited and found correct.
(Signed) JAMES HOUSTON,
MRS. E. L. TAYLOR.
December 10, 1930.

J. H. KOLB,
Treasurer.

VICTORIA TREASURER'S REPORT

Receipts

Balance from last year	$ 43.48
Membership Fees	203.00
Grant from parent Society	73.00
Bank Interest	2.50
Sundries	.40
	$322.38

Expenditures

Remittances to parent Society—Membership fees (1929)	$171.00
Life membership fee (1929)	25.15
Advertising	42.61
Stationery	7.57

Printing	15.91
Janitor	20.50
Postage	11.66
Sundries	.70
	$295.10
Balance on hand	27.28
	$322.38

PHILIP H. HUGHES,
Treasurer.

Audited and found correct.
W. T. BRIDGE, *Auditor.*

LONDON FINANCIAL STATEMENT

Receipts

Balance in Bank	$ 72.48
Members' fees	104.00
Donation for annual meeting in lieu of food	4.00
Bank Interest	2.04
Grant from R.A.S.C.	50.00
	$232.52

Expenditures

Fees remitted to R.A.S.C.	$106.04
Annual meeting expenses	5.50
Flowers to Mr. Ed. Read	2.50
Bank exchange	.15
Telescope transportation	1.50
	$115.69

Receipts	$232.52	
Expenditures	115.69	
Balance in Bank	$116.83	
Stamps on hand	.90	
Total assets	$117.73	

H. S. WISMER,
Treasurer.

Audited and found correct.
G. R. MAGEE,
S. A. OLHEISER.
December 12, 1930.

RADIO TALKS OVER CFCF, VICTORIA, B.C.

By W. E. Harper

XXXIV.—Making Astronomy Popular

(October 17, 1930)

SOMETHING new has appeared in the realm of science, something fundamentally different from all achievements of the past years in this particular field. It is an instrument nobly conceived and splendidly developed for the purpose of popularizing the great subject of astronomy.

Our prehistoric ancestors were greatly interested in the sun and moon and in the planets and the stars, and made great strides in comprehending their movements. It is true that up to a few hundred years ago they laboured under the mistaken notion that the earth was at the centre of the universe and that all the other heavenly bodies were revolving about it as a centre. Eventually it was realized that the sun was the centre of our solar system and about it moved the various planets, each in its own period of time. Various mechanical devices were constructed to illustrate the motions of these heavenly bodies, some of them revealing great ingenuity and skillful workmanship on the part of the makers.

In this work of popular education along scientific lines, the European continent has been considerably in advance of our own, as is only natural since ours is a newer country. The best of such mechanical devices to represent the solar system is that set up in the museum at Munich, Germany. In the centre of a circular room some forty feet in diameter is an illuminated globe suspended from the ceiling. This is to represent the sun. Six of the planets are shown suspended at their proper relative distances and caused to revolve about the centre at their known rates of speed. As the room is painted dead black, all the light received on the planets comes from the central sun and thus a very true representation of actual conditions is secured.

But this represents the view as seen by an observer on the outside and fails to visualize things as one sees them from the earth.

Furthermore, the stars are not shown. To accomplish this is the aim of the instrument designed by the Zeiss Optical Works, which was first put on the market a few years ago. It was my privilege to witness a demonstration of such an instrument last month at Chicago while attending a meeting of the American Astronomical Society. This "planetarium," so-called, was completed this past summer and is the first one on the American continent. In connection with it is an astronomical museum, the whole works costing about three-quarters of a million dollars, the initial cost being borne by a wealthy citizen, Max Adler, whilst the upkeep is borne by the South Park Commission.

While the building is twelve-sided, each side corresponding, I suppose, to one of the signs of the zodiac, yet the planetarium proper is the central circular room, 68 feet in diameter, surmounted by a hemispherical dome. On the inner surface of this dome are represented the stars and other heavenly bodies just as we see them by night. This is accomplished by a battery of projecting lanterns, each of which throws a section of the sky on the curved dome. All these projectors are coordinated and unified in the instrument placed in the centre of the room and whose motions can be controlled by the lecturer.

In addition to the projectors which give a faithful representation of all the stars in the sky that can be seen by the naked eye, there are additional projectors for the sun, moon and the various planets. Each of these has a separate mechanism so that their motions among the stars will be accurately represented. The moon is seen to pass through its various phases from crescent to full moon and in the reverse order during the course of the 29-day period. By speeding up the mechanism this can be shown in the course of a few minutes. The planet Mars, whose period about the sun is 687 days, and Saturn, which requires almost 30 years to perform the circuit, as well as the other planets, are all equally faithfully represented in their motions in the starry firmament. It is stated that the mechanism is so perfect that once set in their proper places among the stars, the planets will maintain their correct positions for ages to come.

The machine is almost uncanny in its action and is bound to give a thrill even to a matter-of-fact astronomer, to say nothing of

those who have thought only casually of such things. I shall try to give you my impressions as with members of the A.A.S. and other invited guests we witnessed a demonstration. To the strains of suitable soft music the lights were gradually dimmed. As one's eyes became accustomed to the deepening twilight you were looking expectantly for the stars. Eventually the brightest ones were seen, then fainter ones, until the whole heavens were ablaze. Thinking it over afterward, the fainter stars must have been projected at the same time as the brighter, but naturally one caught the brightest ones first. The same dramatic representation was given to the oncoming of the dawn, the fainter stars disappearing first, then the brighter ones, one by one until daybreak was at hand.

By rotating the instrument, the one in charge (the director, Philip Fox) could make the diurnal rotation of the heavens seem very real. Well-known stars would rise in the east, mount higher in the heavens and eventually set in the west. The apparatus in its normal position is constructed for the latitude of Chicago, but by simply inclining the axis one can have the aspect of the heavens as seen by observers in other lands. Thus we were taken on an imaginary journey to the southern hemisphere and as we proceeded southward, the well-known stars of our northern skies sank below the northern horizon while new stars came up in the south to take their places. Familiar objects like the great hunter, Orion, seemed strangely unfamiliar when viewed upside down.

Moreover, by speeding up the mechanism we were given the appearance of the heavens as it will be thousands of years hence to those who occupy our places here. Due to a slow movement, known as precession of the equinoxes, the axis of the earth keeps pointing in a different direction from year to year and soon Polaris will have to give up its claim to being the pole-star.

Even to country dwellers, who, happily, can see the sky in all its natural beauty, this device will make its appeal. How much more, then, is it likely to do so to those in large cities who rarely see the skies. Possibly this accounts for the tremendous number of visitors the Adler planetarium at Chicago has had, for during the first three and a half months of its operation over 400,000 visitors have been thrilled by the demonstrations given.

XXXV.—Keeping A Telescope Fit

(November 21, 1930)

A GOOD craftsman keeps his tools in the best of order. The very fact that one is working with them in the pink of condition seems to have a reflex action, as the worker can not only accomplish more but feels impelled to produce nothing short of the very best. Astronomers find this true in their work, for if the micrometer screw of the engine with which one is measuring is sticky and does not move freely, then he is very likely to find himself getting careless about the measures themselves. One has always to be on guard in these things, particularly where one is dealing with displacements on the photographic plate of a ten-thousandth of an inch or less.

It is equally important to keep the main tool of the astronomer —the telescope—in the best of condition also. The large telescopes of the modern day are operated largely by electric devices and usually an engineer is on the staff, whose duty primarily is to see that this electrical equipment is always in working order. Such being the case in our observatory at Victoria, consideration need only be given to the main part of any telescope, the light-gathering lens or mirror. In a refracting telescope the lens is placed at the outer end of the tube; the light from a star or other heavenly body passes directly through it and is condensed to a point image at the eye end. In the reflecting type, like the telescope at Victoria, the light-gathering mirror is placed at the bottom of a long tube and on it falls the light from the heavenly body. The mirror's surface is so shaped that all this light is reflected to another mirror and eventually converges to a point image.

In the case where we have the lens at the outer end, very little attention has to be paid to it other than seeing that it is always protected by a suitable covering when not in actual use. This lens, however, is usually made up of two or more elements and between these moisture and dust will eventually find their way, thus lessening the efficiency of the lens. There is no recourse but to give it a bath whether it likes it or not, though if proper care is taken it need not undergo this ordeal more often than once every ten years or so. The operation, while a simple one, calls for a steady hand and

extreme care, as chipping of either component might ruin a lens costing thousands of dollars.

But my purpose is mainly to speak of how to keep the mirror in the best of condition. Most of you know that it is circular in shape, six feet in diameter and slightly concave outward. The concavity is not extreme for if a straight edge were placed across the mirror, the depression at the centre would be only about nine-tenths of an inch. This surface, which has been ground by the maker to an extremely accurate shape, is silvered over and highly polished, so that it will reflect the utmost possible amount of light incident upon it. Unlike the ordinary commercial mirror where the silver is deposited on the rear surface and protected from the weather by a particular preparation painted over it, ours is on the front surface and is always exposed to weathering influences. Various agencies cause it to deteriorate and lose the high reflecting power it possessed when first deposited. Smoke from forest fires will rapidly cause it to tarnish, dust particles will settle on it and with moisture will cause stains. A warm spell following a protracted cold will almost surely cause the mirror to "sweat," as it is called, and usually the fine film of silver is lifted in spots. While we are possibly much more free from this latter trouble here than we would be anywhere else in Canada, we usually suffer from it at least once each winter season. For various reasons, then, it becomes necessary to re-silver the surface two or three times a year if the telescope is to be maintained in any state of efficiency. For if the reflecting power of the silver coat diminishes, say 50 per cent., it means you are forced to give exposures double the length of time that would normally be sufficient.

The silvering of the 72-inch mirror is not a small undertaking. To begin with, it weighs over two tons and it and the containing cell about six tons. The first step is to detach the mirror with its containing cell from the telescope and place them on the silvering car, specially designed for the purpose. Here they are supported at three points, the mechanism permitting the cell to be rocked slightly when the silvering solutions are poured on the mirror. This may be said to constitute the first phase of the proceedings and this work is almost wholly left in the hands of the engineer and caretaker.

The next step is to clean off the old coating of silver. Dry cotton

wool will remove loose dust while swabbing with a good handful of wet wool will next be in order. Then comes the use of nitric acid to remove the old silver coating. After rinsing, caustic potash is used to remove grease or oil stains which may have unfortunately accumulated. Rinsing, followed by another swabbing with nitric acid and again plenty of rinsing completes this step. A strip of waxed paper is now tied tightly around the edge of the mirror and sufficient distilled water is placed upon the mirror to cover its surface an inch or so in depth.

The third step is the preparation of the silvering solutions, which must be very carefully done, using only the purest chemicals. Two pounds of silver nitrate are dissolved in a suitable amount of distilled water and precipitated by means of ammonia. One pound of caustic potash, dissolved in water, is added to the nitrate solution and the whole is then cleared up by adding the necessary amount of ammonia. This is the silvering solution proper.

Another solution, known as the reducing solution, has already been prepared, as it improves with age. It consists mainly of rock candy and alcohol. The latter has no appeal to any of the astronomers but they possibly are partial to the candy; however, as such a solution is prepared only once in about five years, our chances for getting sweet are not numerous.

When all is ready a suitable quantity of this reducing solution is mixed with the silvering solution as the latter is being poured on the mirror on which, as mentioned, there is an inch or so of distilled water. The chemical action at once begins and at such a time one can only hope and pray that none of the thousand and one things that should have been done were omitted. As the solution is kept agitated by rocking the mirror, one can watch the deposit increasing in amount from the time it starts in three or four minutes until the solutions are drained off in fifteen or twenty minutes. Usually there are two groups of workers used; one to clean off the mirror, the other to prepare the solutions. Should failure appear a possibility in the anxious moments when the reaction is taking place, there is always good ground for argument as to whether the mirror was improperly cleaned or the solutions poorly prepared. However, as in the past six or seven years it has been our good fortune not to have a failure, it has never been necessary to continue the argument.

The solutions are rapidly drained off when it is judged the proper thickness of coating has been given and then all sediment is washed off carefully before the mirror is allowed to dry. Usually half a day is allowed before the silver coat is burnished by means of chamois cloth on which often finely-powdered rouge is imbedded.

The mirror is then returned to its position at the lower end of the tube and the process is over for the next six months, as two silverings a year seem to be about all that is necessary in our location. Usually one night is lost in the operation, although if deemed essential, it can be speeded up so that no interruption in the observing will occur. The secondary mirror is naturally always silvered at the same time as the main one.

XXXVI.—The Tides

(December 23, 1930)

IN a former radio talk I tried to show how nonsensical was the notion that the moon had anything to do with the weather or that it exerted any influence over human beings in the way some people suggest. Nevertheless, the moon does exert an influence upon the earth in that its attractive force causes the waters upon the earth to bulge upwards towards it, resulting in the rising and falling of the tides twice a day.

Before the dawn of modern science the tides ranked among the greatest of nature's mysteries. It is not surprising that the steady, rhythmical rise and fall suggested to some imaginative minds the breathing of a mighty monster of the deep. But as long ago as the times of the ancient Greeks and Romans it was known that these phenomena were connected with the motion of the moon, although it was not until Newton discovered the law of gravitation that the full explanation could be given. According to this law every body attracts every other body with a force proportional to the product of their masses and inversely proportional to the square of the distance between them. Thus the moon, whose mass is only 1/81 that of the earth, is pulling across the intervening space of 240,000 miles whilst the sun, with a mass 332,000 times the earth has to

exert its influence across the much greater distance of 93,000,000 miles. This greater distance of the sun more than offsets its greater mass and in consequence its tide-raising force is only half that of the moon.

The average interval between corresponding high waters on successive days is $24^h\ 51^m$, which is exactly the same as the interval between successive passages of the moon across the meridian. The coincidence, maintained indefinitely, makes it certain that there must be some close connection between the moon and the tides.

At the time of new or full moon, the sun and moon will be pulling in the same straight line on the waters of the earth and will heap them up much higher than the average. These are known as the *spring* tides. At the times of first and last quarter, when the moon is pulling at right angles to the sun, the tendency will be for these forces to cancel each other. Thus we have the lowest tidal disturbances known as the *neap* tides.

The attractive force of either sun or moon is exerted not only on the waters of the earth but on the solid earth itself. The waters being mobile respond more readily to the attraction, however, and in consequence are heaped up at a point directly under the attracting body. Moreover, the waters on the earth directly opposite to the attracting body are left behind, as it were, when the earth as a whole responds to the attracting force. If the earth's surface were entirely fluid the rotation of the earth would give the impression that these two humps of water were continually travelling around the world, once every day. At any given part of the earth's surface, therefore, there would be two humps daily, that is, two periods of high water. Such in brief is the gravitational theory of the tides.

Since the exact positions that the sun and moon will occupy in the heavens can be calculated years in advance, it is theoretically possible to calculate in advance also the times of high and low tide in any harbor of the world. However, there are so many variable factors that one would almost despair of solving the problem. To mention only a few of these we have the sun and moon varying not only in their positions in the sky but in their distances from us as well. The rotation of the earth, the configuration of the land areas of the globe, the varying depths of the different oceans with the physical properties of the water itself make the problem so com-

plicated that in actual practice the procedure has been adopted of working backwards from the observed tides to predict those of the future. It is essential that such tide tables be prepared well in advance and in the hands of mariners so that they can take full advantage of high tide in navigating shallow harbours.

In the open ocean the range of the tides averages about two and a half feet. On the coast the range is usually greater, for the oscillations tend to grow higher as they run into shallow water. In shallow water, too, the wave moves slowly so that the time of high water differs widely at stations only a few score miles apart. Where the configuration of the coast forces the tide into a narrow opening the range becomes very great. Thus at the head of the Bay of Fundy the mean range of spring tides is fifty feet, and in certain other parts of the world it is similarly high.

Much discussion has taken place regarding the feasibility of using the rise and fall of the tide as a source of power. In general, the range is so small that the plan is not practical. I believe, though, in New Brunswick, at the confluence of the Petitcodiac and Memramcook rivers, where the tides are from 30 to 40 feet high, dams have been constructed in such a way as to give to the power plant a head of water which fluctuates only between 27 and 15 feet. The result is cheap electric power in the adjoining portions of New Brunswick and Nova Scotia, where the cost is ¾ cent per kilowatt hour, for large power users, up to 4 cents for small lighting service.

On the banks of this Petitcodiac river, I am told great droves of pigs from the adjoining farms wander, seeking food when the tide is out. For hours they wallow and grunt, rooting the damp soil up with their snouts, not appearing to notice anything around them. Suddenly, without any warning, the herds make a wild dash for the shore, squealing wildly as they rush along. An observer can see no reason for their wild scamper until a few minutes have elapsed when the great mass of water, known as the "bore," comes rushing up the river, completely covering the land whereon they had been feeding a few minutes earlier. One wonders what sixth sense the pigs have to warn them, as they have never been known to be caught in the tide.

Tides are present not only on the ocean but to a lesser extent on smaller bodies of water like our inland lakes. In 1905, Professor

W. J. Loudon, of the University of Toronto, found a tide of about three inches to exist on the shores of Georgian bay, where he was summering, and his result has been corroborated the past summer by Professor R. K. Young of the same university. At Chicago, on Lake Michigan, the range is about two inches.

My unseen audience doubtless will accept the evidence that tides exist on our lakes and rivers, but may not be prepared to accept my next statement that there is a tide in the crust of the solid earth itself. This was beautifully demonstrated by Michelson in 1913 at the Yerkes Observatory. Two pipe lines, each 500 feet long, one running north and south, the other east and west, and each half filled with water, were laid in a trench. By means of glass windows at either end of the sealed pipes, one could read the height of the water level, as indeed it was the privilege of the speaker to do when on a visit there in that year. All the phenomena of the tides were faithfully reproduced by the water inside the pipes, only in every case the heights were only 69 per cent. of their predicted values. The reason for this is that the solid earth is elastic and rises, falls and tilts as that of a liquid sphere would do though only to 31 per cent. as great an extent. Thus the actual rise and fall of the earth's surface has for its maximum value about nine inches.

As the earth turns on its axis once every 24 hours, there will be as just mentioned two humps of water travelling westward, one nearly directly under the moon and the other 180 degrees distant. In the open sea these will act as a kind of brake to the earth's rotation, which braking power will be much accentuated on the coast lines where the tides become impounded in narrow gulfs and basins. Thus it is only reasonable to suppose that the earth's rotation is gradually slowing down, or in other words that our day is becoming longer. In the past few years this theory has been fairly well substantiated since it accounts remarkably well for the residuals between the computed and observed positions of the moon over a considerable interval. Such is the refinement of astronomical observation, then, that we can state that the day is increasing in length at the rate of 0.001 seconds per century.

Conversely, by working backwards we come to realize that formerly the day was much shorter than now, and millions of years ago, when the moon was just parting company with the earth, the

day was of the order, not of 24 but of 5 hours. The earth and moon were then in contact and mutually swung around each other in that short space of time. Those were the days of mammoth tides.

XXXVII.—How Far To The Sun

(January 16, 1931)

THE question of the distance of the sun from us is vital to our obtaining a correct scale of the universe. The stars and other remote celestial objects are all rated as regards distance in terms of the sun's distance from us. We rather glibly say this distance is roughly 93,000,000 miles without any appreciation of its magnitude or of the precise astronomical observations necessary to deduce it. It has thus seemed that a few minutes might profitably be spent in explaining how this distance is measured. The subject is a very timely one by reason of the fact that this week sees astronomers in all parts of the world making observations upon a particular object which is most suitably situated in the heavens for that purpose. Preparations have been going on for several years past in anticipation of the favourable opportunity of the next few weeks to observe the little planet, Eros by name, which comes closer to us now than it has for the past 37 years.

Let us refresh our memories with a picture of the solar system and see what objects are near us. There are eight main planets (or nine if the one discovered at Lowell early last year be counted) moving about the central sun at increasing distances from it. Mercury is the closest, then comes Venus, then the Earth and then Mars. Just outside of the orbit of Mars are great numbers of very small planets. Let us stop there. Venus is within our orbit, Mars without, and of these two, Venus comes the closer to us. From a knowledge of the periods required by the planets to move about the sun, we can lay down a plan of the solar system which will accurately show the relative scale of distances. If, then, one of these distances can be determined, we can arrive at them all and thus at the distance of the sun itself. Naturally, astronomers choose the shortest distance to measure and here is where one of these little planets

outside of the orbit of Mars is so very obliging. Its orbit is quite eccentric and this year it happens to come in close to us—a matter of 16 million miles, it is true—but that is very much better than Venus ever does, which at best is 26 million miles. Moreover, Eros is a very tiny planet, not more than 15 miles in diameter, and shows as a mere point of light. It is accordingly much easier to register its precise position with our instruments than in the case of Venus, which shows an appreciable disk.

But you ask me how can we measure this distance? True, it is only about one-sixth of the sun's distance but nevertheless it is 16,000,000 miles. It is the land surveyor who gives us the method of attack. If the surveyor wishes to obtain the distance to some inaccessible point, like a mountain peak, whose distance cannot be chained off directly, he resorts to a scheme like this. He measures off accurately a base line, chosen preferably at right angles to the direction of the peak. If the latter is forty miles away, then a base one mile long is more than ample. Setting up his instrument at each end of the base, he sights on the peak and reads the angle which it makes with the base line. He thus has a triangle with known base and base angles and from a knowledge of ratios in triangles one can deduce the lengths of the other two sides. That is to say, the solution gives the distance of the peak from either end of the base.

This method is used to get the distance to our nearest neighbour, the moon, which, as a former part of the earth, has not got very far away from us as yet. Observers in the northern and southern hemispheres, say at Victoria and Capetown, agree to observe the moon at a definite moment. The observers' distance apart is known from the size of the earth and the observed altitudes of the moon at the two separated stations give us a triangle that can be easily solved to give us the distance of the moon as approximately 240,000 miles.

In the same way observers both in the southern and northern hemispheres have made plans for cooperation in triangulating this little planet at this favourable opportunity. In this case visual observation will be replaced by photographic, and plates taken at stations widely separated on the earth's surface will, when compared with respect to the background of distant stars, give us the data for deducing its distance. Of course it is not suggested that

one single observation north and south will suffice; an almost continuous photographic record of its position will be made by cooperating observatories over several weeks' time. Due to its own motion about the sun, which requires 1¾ years to complete, and to our earth's motion, the planet will shift its position rapidly among the stars. These background stars have been very accurately determined for position during the past five years and so it is hoped to be able to assign to the little planet at any instant an accurate position as viewed from stations scattered widely over the earth. The detailed analysis and mathematical treatment of the results will require considerable time but when complete they will give the distance of the planet, from which as previously suggested, the distance of the sun is easily deduced. The present accepted value of the sun's distance is 92,870,000 miles with a probable error of 11,000 miles. The little planet is rather interesting in itself. There are over one thousand such now known to exist and as previously stated, they move in orbits about the sun between the orbits of Mars and Jupiter. The great majority of them are from ten to fifty miles in diameter and collectively they would make only one decent-sized planet. Probably a planet here failed in the making or else exploded after it was formed.

Eros varies greatly in its brightness in a period of about five and one-quarter hours. Why this should be is not known with certainty but the fact stands out it can double its brightness in an interval of about two hours. In explanation, it is thought that the planet is rotating and one-half its surface is a much better reflector of the solar rays than the other half. We must remember all its light comes from the sun since, like the earth, it is non-luminous of itself. It is too faint to be seen by the naked eye. Much additional information is expected to be gleaned from the present opposition.

REVIEW OF PUBLICATIONS

The Stars of High Luminosity. By Cecilia H. Payne. Pp. xiii, 320, 5½×8¾ in. Harvard Observatory Monographs, No. 3. N.Y., McGraw-Hill Book Co. 1930. Price, $3.50.

This volume is intended to replace the same author's "Stellar Atmospheres," which was published in 1925 as Harvard Monograph No. 1; and as the progress made in the last five years has greatly altered the aspect of the subject, the new work is quite different from the old. The amount of material analysed by the author has been very large and the results deduced are clearly expressed in numerous diagrams and tables.

In Part I is a statement of the problem attacked, with a discussion of the photometry of spectra and the interpretation of the forms of spectrum lines. The author aims to "consider the high luminosity stars in their bearing on related stars and affiliated problems." In Part II is an outline of the material available. Several hundred thousand stars may be regarded as members of the high luminosity group, but in the present study the limit is set at absolute magnitude minus 2. Only a small fraction of the known stars of high luminosity are spectroscopically accessible. Part III discusses the results of observation, including stars of classes from O to M, as well as the red supergiants and the variable stars. Part IV gives an analysis of stellar atmospheres, and at the end are lists of c-stars and Cepheid variables.

In view of the tendency to multiply the number of theories seen in some quarters, the author makes a very sensible remark:

> The problem of spectral and stellar classification is still to be solved. Effective temperature is a valuable parameter (though sometimes, perhaps usually, ambiguous), and it and the percentage ionization of a substance of suitable critical potentials are suggested as a basis for the classification of spectra. But it must be emphasized that to propose a system of classification is trivial: to apply it successfully to the arrangement of stellar spectra would be a contribution of real importance.

The treatment of this very modern subject is highly technical. The subject is developing rapidly and the present work is a sort of report of progress. It will be of immense value to workers in all countries who are endeavouring to solve the problem of the physical conditions in the atmosphere of a star. C. A. CHANT.

NEWS AND COMMENTS

A building to be erected for Harvard College Observatory at a cost of $100,000 is planned for the safe preservation of the photographic collections and other records of the observatory. Irreplaceable pictures of all portions of the sky—the earliest of them made in 1850—taken from the northern and southern hemispheres and now stored in a wooden building, will be laid away for future study and reference in special vaults which will be placed in the projected building. Numbering more than 350,000 plates, and accumulated at a cost in excess of $1,000,000, the collection is five times larger than that of any other institution in the world. Space will be allowed for the collections of the next forty years. (*Science.*)

From newspaper accounts it appears that the dense fogs which settled over Europe in December, with fatal results in Belgium, were due to terrific sand-storms blowing northward from Africa following a disastrous seven months' drought, the finer dust settling slowly and forming nuclei for fog particles.

Dr. S. A. Mitchell, director, Leander McCormick Observatory, University of Virginia, will deliver on March 26 one of the series of lectures of the Franklin Institute, Philadelphia, on the subject, "The Structure of the Atom Under Conditions of Temperatures and Pressures in the Sun's Atmosphere".

Professor T. H. Matthews, Registrar of McGill University, who lectured to the Ottawa Centre of the Royal Astronomical Society of Canada on January 30, made a friendly call at the Dominion Observatory on the following day, visiting the various divisions.

"Cheer Up, Cheer Up, Cheer Up",—so sings the robin in the sub-zero conditions at the Observatory in Ottawa,—"Faith in Spring, Cheer Up".

REDeL.

NOTES FROM THE DOMINION ASTROPHYSICAL OBSERVATORY

Approximately 309 persons visited the observatory during the month.

The weather all through January was very mild, no snow occurring and practically no frost. The observing weather was poorer than the average; while work was carried on on ten nights, most of them were quite poor. A total of 58.0 hours was secured, as against the twelve-year average for the month of 70.5 hours. We have had more fog than usual and while there never are extreme changes of temperature, one rather rapid rise caused the mirror to fog badly. To prevent similar occurrences in the future, experiments are being conducted with small heating units near the surface of the mirror so that it can be rapidly brought into agreement with, or slightly higher than, the outside temperature.

The director, Dr. J. S. Plaskett, attended a meeting of the chairmen of the various divisions of the Pacific Science Congress to make further arrangements for the fifth meeting which comes to Canada in the spring of 1932. The programme for the astronomical section is rounding into shape in so far as it can be planned this far ahead.

We regret to inform JOURNAL readers that Dr. Roy O. Redman has resigned from the observatory staff to accept the assistant directorship of the Solar Physics Observatory at Cambridge, England. Dr. Redman came to us in August, 1928, as a temporary assistant for one year and was appointed to the permanent staff at the conclusion of the twelve-month period. Late in December of last year he was offered this position by the director, Stratton, and notification has now been received that he has been officially appointed, duties to commence April 1. He leaves on February 14 and plans to visit the main observatories in the United States as he goes eastward. At a recent seminar meeting his co-workers here presented him with a leather suit case as an expression of appreciation of his work, and coupled with it their best wishes for success in his new field of labour.

February 4, 1931. W. E. H.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

A Bright Meteor—Observations Wanted

On the evening of January 22, at about 6 o'clock, E.S.T., a brilliant fireball passed Philadelphia, travelling a little north of east. Observations made at Ithaca, N.Y., and in Vermont indicate that it was moving almost horizontally and still "going strong." Professor Olivier, of Flower Observatory, University of Pennsylvania, is anxious to receive reports from points farther north. If any of our readers in Quebec can supply information it will be welcomed. Send it at once to Professor Olivier.

Meteor Crater—Divergent Views

In the January number of this Journal was an article on the Meteor Crater in Arizona by Professor H. L. Fairchild, which had originally appeared in *Science* of November 7, 1930. In it the view was expressed that the body producing this wonderful cavity in the earth's surface was a single stony meteorite containing nodules of nickel-iron, and that the stony part was destroyed by the impact and by weathering, leaving the nickel-iron fragments behind, many of which have been found.

As might be expected, Professor Fairchild's theory has called forth opposing views. In *Science* of January 9, 1931, is a letter by Frederick S. Dellenbaugh, of New York, who is sceptical of the meteoric nature of the hole and insists that it is entirely the work of erosion.

Then follows in the next issue a discussion by D. Moreau Barringer, Jr., of Haverford, Pa., whose father has sunk shafts in the crater and has otherwise explored it and the surrounding country. Indeed it was largely through his investigations, which were presented to the National Academy of Sciences in 1909, that the theory that the crater was meteoric in nature has been generally accepted. Mr. Barringer states that some of the nickel-iron meteorites were so well protected by the rock flour of crushed

sandstone about them that any stony matter in which they had been embedded would not have been decomposed. While a great many iron meteorites have been found in the neighbourhood, not a single stony meteorite, or a single piece of rock foreign to the normal geology of the region, has so far been discovered, and it is natural to believe that if the original mass had consisted largely, or even to a slight extent, of stone, and if any stone had survived the impact, some of it would have been preserved.

The problem is full of difficulties, there are so many unknown factors which must be considered. At the Chicago meeting of the American Astronomical Society an important paper on this subject was presented by Professor F. R. Moulton. He discussed what would happen if a solid mass struck a large body like the earth with a cosmic velocity, such as ten miles per second, and he showed that some remarkable results would follow—perhaps a reduction of the smaller body to dust. These immense velocities are seldom taken into account in problems on impact. Mr. Barringer argues his case effectively, but the effects from very high velocities require further consideration.

Venus as a Crescent with the Unaided Eye

I have always been sceptical about the reports of persons seeing Venus as a crescent with the unaided eye, as I have looked at the planet thousands of times and failed to see a crescent form. Recently, however, in the early morning I was surprised when looking up at Venus to see what appeared to be a distinct crescent and with the outside of the curve facing the unrisen sun. There was a faint haze in the atmosphere and the crescent did not appear quite sharp. Some twenty minutes later I looked again. The haze had gone and so had the crescent: the planet appeared as a bright star. The same experience was repeated in reverse order some mornings later. The first view showed no crescent, but half an hour later sure enough there was the crescent shape again in a slight haze.

Can this possibly be caused by refraction, somewhat similar to the enlarged solar disc that is sometimes seen just above the horizon? Venus was 20 or 25 degrees above the horizon on both occasions. The impressions were quite definite. I do not think it was imagination.—David J. Howell, Toronto.

Early Photographs showing Pluto

On January 23, 1914, a photograph was taken at the Königstuhl Observatory, Heidelberg, which contains the image of the body now known as Pluto. This plate was found by Dr. Max Wolf, director of the observatory, who searched for it in his large collection of negatives. The position of the planet as determined from this plate will assist in calculating its orbit. It has been discovered also that a plate taken at the Lowell Observatory itself in 1915 contains the planet. Quite probably Professor Lowell handled this very plate and saw the image of the body he was searching for but it was not as bright as he expected and was indistinguishable from the multitude of star images.

Royal Astronomical Society Medals

The Gold Medal has been awarded to Professor W. de Sitter, of Leyden, Holland, for his theoretical investigations on the orbits of the satellites of Jupiter and his contributions to the theory of relativity.

A Jackson-Gwilt Medal and Gift have been awarded to Mr. Clyde W. Tombaugh, of the Lowell Observatory, for his discovery of the planet Pluto. This medal is given at intervals of not less than three years nor more than seven and is bestowed "for the invention of a new astronomical instrument or the discovery of a new astronomical body." The medal is of bronze and bears on one side the portrait of Sir William Herschel who sprang into fame by the discovery of Uranus in 1781.

A Good Test of a Theory

Dr. Dinsmore Alter, professor of astronomy in the University of Kansas, has given much attention to the analysis of meteorological records, and, having obtained a year's leave of absence, he spent it in England studying the problem of periodicity in rainfall. In that country a long series of comparatively homogeneous observations of rainfall is available and to these Dr. Alter applied the mathematical method known as the "periodogram". He

found eleven separate periodic terms in the rainfall records and he now predicts what will happen in the next ten years.

The promised showers or lack thereof may be summarised as follows:

1931. Deficiency of rain in first half of year.
1932. Much rain in second half.
1934. Much rain in first half.
1935. Much rain in first half.
1936. Deficiency throughout the year, especially in first half.
1937. Excess of rain in latter half. In this year 43 per cent. above the mean.
1939. Deficiency in first half.
1940. Deficiency in second half.

It will be interesting to see if these predictions are verified.

ASTRONOMICAL ACHIEVEMENTS IN 1930.

For the last few years the president of the Royal Astronomical Society of Canada has given in his annual address a review of progress in astronomy during the past year. This year President Kingston varied the custom, and so, with the permission of *Science Service*, a list of interesting happenings in the astronomical world during 1930 prepared by that useful organization is presented.

A new planet, the first to be discovered since 1845, was found photographically with a 13-inch telescope at Lowell Observatory in approximately the place predicted by the late Professor Percival Lowell, founder of the observatory, who died in 1916. The planet, which is farther from the sun than any other yet discovered, was later named Pluto.

That inter-stellar space, especially in the plane of the Milky Way, is not transparent, but filled with diffuse material that absorbs a considerable amount of light from distant stars, thus making the previous estimates of their distances too large, was indicated by researches of Dr. R. J. Trumpler, of the Lick Observatory, supported by independent work of Dr. Piet van de Kamp, of the Leander McCormick Observatory.

A faint group of nebulae was found to be apparently speeding away from the earth at the rate of 7,200 miles a second, the highest astronomical speed yet recorded, by studies of Dr. Edwin P. Hubble and Milton L. Humason, of Mt. Wilson Observatory, but it is supposed that the effect is really an illusion, due to curvature of space.

The eccentric little planet Eros, which aids astronomers in determining the earth's gravitational power and the sun's distance, approached closer to the earth than it has at any time since its discovery in 1896.

That many stars are spinning at the rate of 40 miles a second, 150 times the speed of the earth at the equator, was discovered by a new method developed by Dr. Otto Struve, of the Yerkes Observatory, in collaboration with a Russian astronomer, Dr. G. Shajn.

An unusually large display of Leonid meteors was visible on the early morning of November 17, suggesting the possibility of a brilliant shower in November, 1932, 1933 or 1934.

Long-range forecasting of weather may be made possible through the discovery by Dr. C. G. Abbot, secretary of the Smithsonian Institution, that there is a close correspondence between changes in the sun's radiation and in temperature at Washington, D.C.

The theory that stars have a structure similar to that of an egg, a dense yolk in the centre, surrounded by a lighter material, was advanced by Professor E. A. Milne, of the University of Oxford.

A new theory of the construction of the universe, that it constitutes a huge system made by the condensation of a loose swarm of smaller clusters of stars which were originally like the mysterious spiral nebulae, was proposed by Dr. Harlow Shapley, director of the Harvard College Observatory.

That Halley's comet had two distinct tails was concluded by Dr. N. T. Bobrovnikoff, of the University of California, after three years of intensive study of 700 photographs taken of the comet in 1910.

The surface of the moon is apparently covered with volcanic ash, according to researches conducted by Dr. B. Lyot, of the Paris Observatory.

The theory that the earth may have a comet-like tail sometimes visible as a faint patch of light called by astronomers the "Gegenschein," was advanced by Dr. E. O. Hulbert, of the U.S. Naval Research Laboratory.

On April 28, the United States saw its first total eclipse of the sun since 1925 when the shadow of the moon just touched the earth on a path which passed through California, Nevada, Idaho and Montana.

A total eclipse of the sun, on October 21, was witnessed by two parties of astronomers from tiny Niuafou Island in the Pacific.

The length of Neptune's day was found by Dr. J. H. Moore, of the Lick Observatory, to be about 16 hours.

A new 50-foot interferometer, a giant instrument for the measurement of the diameter of stars through the interference of reflected light waves, was completed at Mount Wilson Observatory in California.

That arsenic and germanium are both present in some meteorites that fall to the earth was discovered by Dr. Jacob Papish and Zaida M. Hanford, Cornell University chemists.

On November 15, 1930, astronomers commemorated the three-hundredth anniversary of the death of Johann Kepler, the great German astronomer who first enunciated the laws of planetary motion.

America's first planetarium in which the observer may at will see a facsimile of the heavens as they look at any time and from any place, was opened on May 10 at Chicago.

A daily broadcast of cosmic data, including number of sun-spots, solar radiation constant and data on magnetic disturbances, was inaugurated by *Science Service* with the co-operation of the International Scientific Radio Union.

The discovery of seven comets was announced during the year, though one was not confirmed and another was a return of a periodic visitor. The first and fourth were discovered by Drs. Schwassman and Wachmann, of the Hamburg Observatory, Germany, though the former was independently found by L. C. Peltier, an amateur astronomer of Delphos, Ohio. The second was discovered by Beyer, also at Hamburg; the third by Wilk, of Cracow, Poland; the fifth by D. L. Forbes, of Rondebosch, South Africa; the sixth was the re-discovery of Temple's second comet by Dr. George Van Biesbroeck, of the Yerkes Observatory, and the seventh was by Nakamura, of the Kyoto Imperial University, in Japan. Efforts of American astronomers to find Nakamura's comet, which Japanese dispatches said had been observed by Sibata, of the same observatory, were unsuccessful, however.

DEATH OF SIR CHARLES PARSONS.

With great regret we report the death of Sir Charles A. Parsons, head of the firm of Charles A. Parsons & Co., Newcastle-on-Tyne, England, of which the firm of Sir Howard Grubb, Parsons & Co., is a subsidiary. In recent years this latter firm has constructed a number of large telescopes and it has the contract for the 74-inch reflector for the David Dunlap Observatory.

Accompanied by Lady Parsons, Sir Charles was on a cruise to the West Indies and while the ship Duchess of Richmond was in the harbour of Kingston, Jamaica, he passed away at 9 p.m., February 11. A fuller account of his life will be given in a later issue.

C. A. C.

[Minutes of the meetings held over until next issue.]

Supplement to the Journal of the Royal Astronomical Society of Canada, March, 1931

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AND

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Osservatorio Astronomico, Milano via Brera, Italy.
Observatoire Astronomique, Tokyo, Japan.
Sociedad Geografica de Lima, Peru.
Observatorio Astronomico de Cartuja, Granada, Spain.
Khedivial Observatory, Helwan, Egypt.
Observatoire Astronomique Zo-Se, Zi-Ka-Wei, near Shanghai, China.

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

The Astronomical and Physical Society of Toronto was incorporated in 1890, though it had existed some years before this; in 1900 it became The Toronto Astronomical Society; and on March 3, 1903, it was given permission to use the name, The Royal Astronomical Society of Canada.

Its objects are to study astronomy and cognate subjects, to publish the results of its work, and to maintain a library.

For many years the Toronto organization existed alone, but now the Society is national in extent, having active Centres in Montreal, P.Q.; Ottawa, Toronto, Hamilton and London, Ont.; Winnipeg, Man.; and Victoria, B.C. Among its 800 members are a number of leading astronomers and scientists of the world, many amateurs, and, in addition, many laymen who are interested in the culture of the science.

The Society publishes a monthly JOURNAL containing each year about 500 pages of interesting articles and a yearly OBSERVER'S HANDBOOK of about 80 pages, containing valuable information for the amateur observer. Single copies of the JOURNAL or HANDBOOK are 25 cents.

Membership in the Society is open to anyone interested in astronomy. Annual dues, $2.00; life membership, $25.00 (no further dues). Publications are free to the members, or may be subscribed for separately.

Extract from the By-Laws: Candidates who are elected to membership will be attached to a particular Centre, or to a section known as *Members at Large*. Members of the Society who live outside of Canada, or in a province in which there is no Centre of the Society will be considered *Members at Large* and not attached to any particular Centre, unless these members are expressly nominated for membership and attachment to a particular Centre. Members may be transferred from one Centre to another, or to the section *Members at Large* by the Council of the Society if written application for such transfer is made by such member to the Council.

The library and offices of the Society are at 198 College St., Toronto, Ont. Applications for membership or for further information should be addressed to a local secretary (see back of this page) or to the General Secretary at the above address.